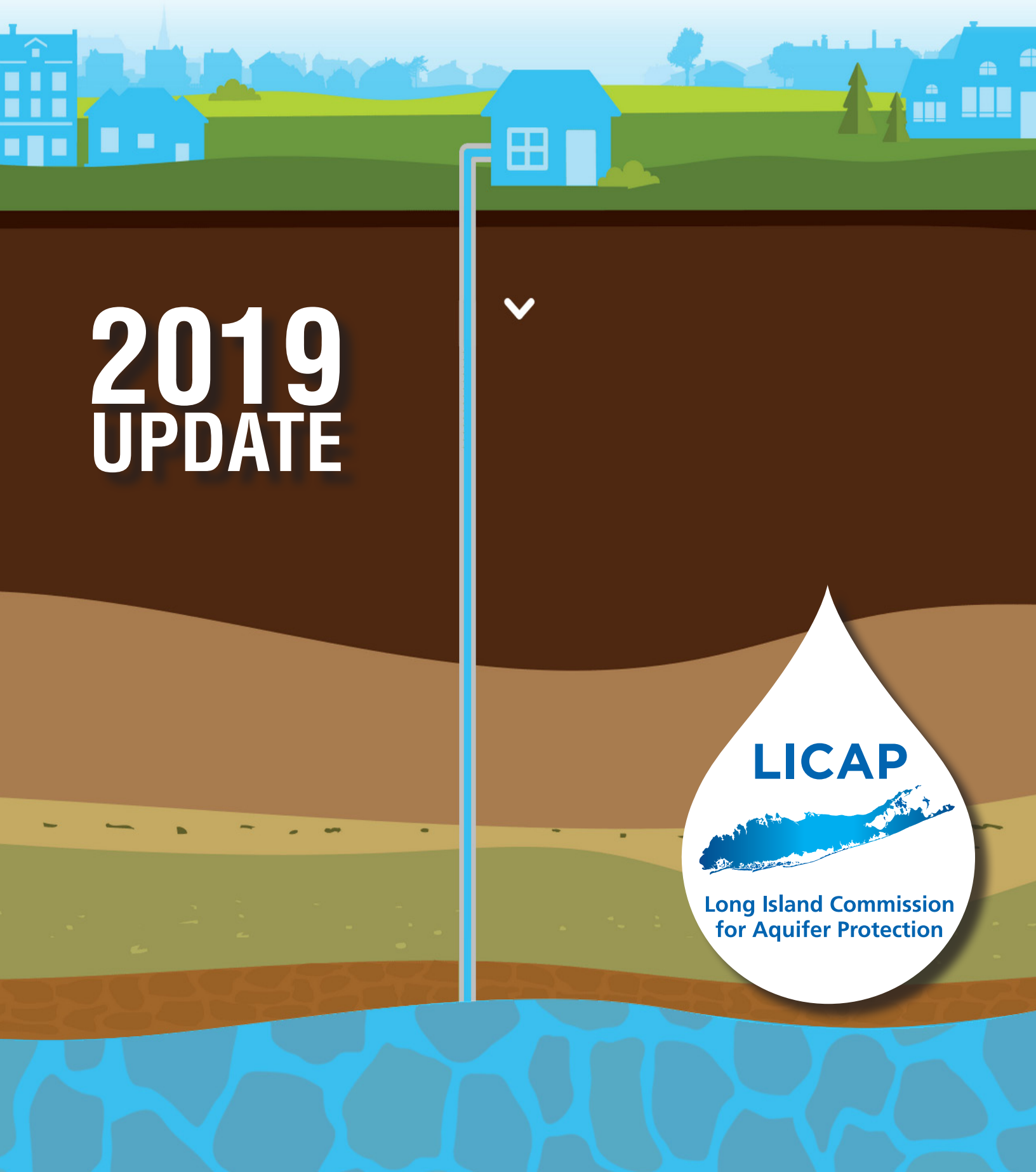
STATE OF THE AQUIFER



2019 UPDATE

LICAP

Long Island Commission for Aquifer Protection

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Long Island Commission for Aquifer Protection

Message from the Chairman

Jeffrey W. Szabo, 2019 Chairman LICAP

As the Long Island Commission for Aquifer Protection, or LICAP, began its second five-year term in 2019, the greatest current threat to the sole source aquifer that provides all of our drinking water was very clear. Groundwater quality had been degraded by manufacturers of several emerging contaminants, leading to the recommendation by the New York State Drinking Water Quality Council in December of 2018 that state officials set some of the toughest water quality standards in the country to address this contamination.

The following report, an annual update to our original 2016 State of the Aquifer report, covers these threats but focuses on one in particular—that of contamination caused by the synthetic organic chemical 1,4-dioxane, which is present in many household products and was used in the past as a stabilizer for industrial solvents, particularly 1,1,1-trichloroethane. The heightened focus on 1,4-dioxane is due to both its prevalence—the chemical has been detected in approximately 70% of Long Island's public supply wells—and the cost to eliminate it, which will be tremendous: 1,4-dioxane requires specialized treatment, meaning that new treatment systems designed specifically to address the chemical must be built at well fields all over Long Island. Each will cost more than $1 million, and in many cases, millions more than that. And that's not including operating costs.

In addition to the featured focus on 1,4-dioxane, this year's report also includes a new structure designed to help readers easily follow changes to various aspects of our aquifer system with each passing year. From this point on, we will provide annual updates on specific topics including hydrologic conditions, groundwater pumpage figures, water quality and water conservation, among other vital topics.

The public water supply professionals, elected officials, environmental advocates and representatives of agencies dedicated to the preservation of public health who make up LICAP are proud to present you this report and welcome your feedback and your involvement in all of our work, which includes our Groundwater Resources Management Plan, which was nearing completion as this report was prepared, and the Our Water Our Lives water conservation campaign. As we seek to do everything in our power to preserve and protect our most significant natural resource for future generations of Long Islanders, we fully recognize that these efforts will only succeed with the participation of the stakeholders who matter most—the residents of Long Island.

Jeffrey W. Szabo,

2019 Chairman, Long Island Commission for Aquifer Protection

LICAP Members

VOTING MEMBERS AND THE ORGANIZATIONS OR OFFICES THEY REPRESENT

Jeffrey W. Szabo
Chairman
Suffolk County Water Authority

Paul Granger
Vice-Chairman
Long Island Water Conference

Stan Carey
Nassau-Suffolk Water Commissioners Assoc.

Walter Dawydiak
Suffolk County Commissioner of Health

Don Irwin
Nassau County Commissioner of Health

Brian Schneider
Nassau County Executive

Dorian Dale
Suffolk County Executive

Chris Ostuni
Nassau County Legislature Presiding Officer

Michael White
Suffolk County Legislature Presiding Officer

David Gamin
Nassau County Soil & Water Conservation District

Corey Humphrey
Suffolk County Soil & Water Conservation District

EX-OFFICIO MEMBERS AND THE ORGANIZATIONS OR OFFICES THEY REPRESENT

Honorable Tom Cilmi
Suffolk County Legislature Minority Leader

Sarah Meyland
Nassau County Legislature Minority Leader

Christina DeLisi
Suffolk County Legislature Presiding Officer

Gilbert Anderson, P.E.
Suffolk County Commissioner of Public Works

Nick Gibbons
Suffolk County Commissioner of Parks, Recreation and Conservation

Michael Comerford
Nassau County Commissioner of Parks

Satish Sood
Nassau County Planning Commission

Carrie Meek Gallagher
New York State Department of Environmental Conservation

Stephen Terracciano
U.S. Geological Survey Long Island Program Office

Henry Bokuniewicz
SUNY Stony Brook School of Marine and Atmospheric Sciences

LICAP Facts

FOUNDED: By unanimous votes of the Suffolk County and Nassau County Legislatures in 2013. Reauthorized in 2018 and extended to 2023.

MISSION: To advance a coordinated, regional approach to the protection of Long Island's sole source aquifer through the preparation of a State of the Aquifer report, to be updated annually, and a Groundwater Resources Management Plan.

MEMBERS: LICAP has 11 voting members. The Suffolk County Water Authority, the Long Island Water Conference, the Nassau-Suffolk Water Commissioners Association and the Nassau and Suffolk Departments of Health are permanent members. Additionally, the Nassau County and Suffolk County Executives each appoint one member as do the presiding officers of each County's Legislature and the Nassau and Suffolk Soil and Water Conservation Districts. There are also ex-officio members with no voting power.

COMMITTEE STRUCTURE: LICAP maintains four standing subcommittees: The 2040 Water Resources and Infrastructure Subcommittee will identify long-term risks to the water supply industry created by global climate change. The Water Resource Opportunities Subcommittee will identify and quantify short-term risks to groundwater resources. The Conservation Subcommittee will develop strategies to educate Long Islanders about the importance of conserving our groundwater. The fourth subcommittee will work in conjunction with Long Island Nitrogen Action Plan (LINAP) working group.

MEETINGS: LICAP is required to meet at least quarterly and hold one public hearing in each county annually.

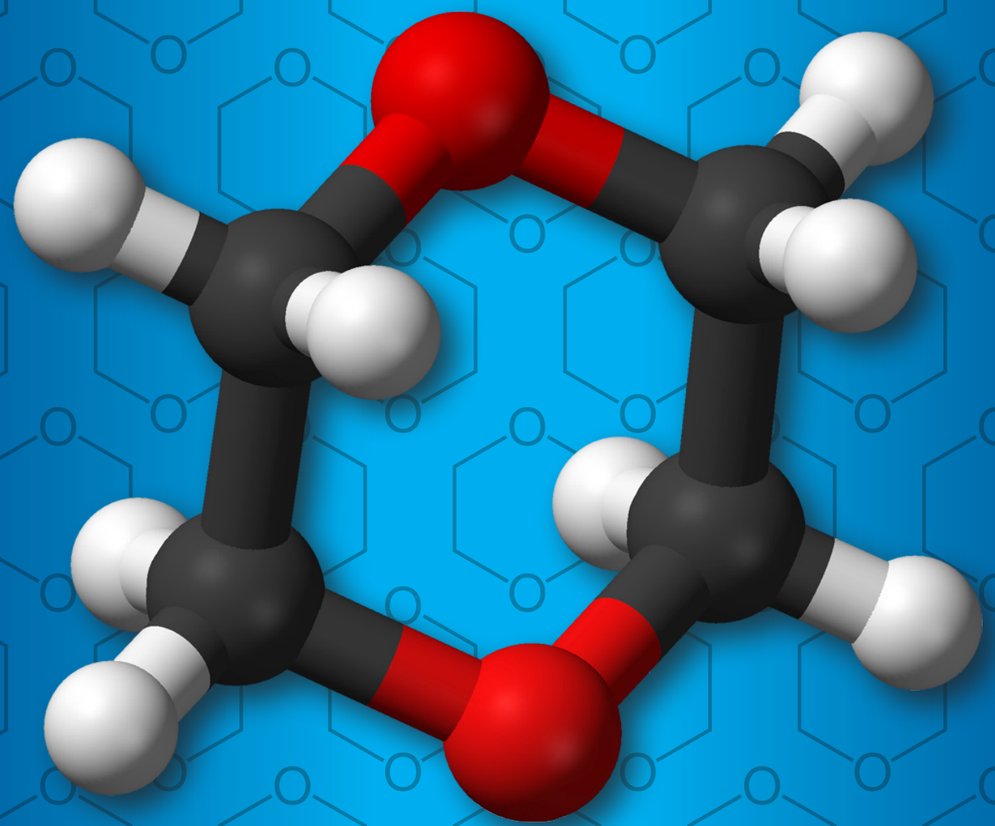
THE STATE OF THE AQUIFER:
Emerging Contaminants and a Replenished Groundwater Supply

As reflected in the following pages, the story of Long Island's sole source aquifer in 2019 has two primary arcs, one a tremendous challenge and the other a positive development.

The challenge, of course, is the threat to groundwater supplies caused by emerging contaminants, particularly the perfluorinated compounds perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) and the synthetic organic chemical 1,4-dioxane. At the time of the publication of this report, state officials are preparing to set water quality standards for all three chemicals that will be among the most stringent in the country. The actions by the state will unquestionably improve groundwater quality, but will also require extraordinary new capital expenditures by Long Island water suppliers, expenditures that will impact Long Island water ratepayers.

The news on available groundwater resources is more positive. Below normal precipitation levels that marked most of the past decade began to change in late 2017. Since then, precipitation levels have been significantly above normal, leading to streamflows and groundwater levels all over Long Island that are now back to normal or even above normal. Despite this, it is still essential for Long Islanders to embrace the conservation of our most precious natural resource, our groundwater supply. So a major focus of LICAP in 2019 was the creation of an educational campaign to accomplish this goal.

1,4-DIOXANE



1,4-DIOXANE: WHAT IT IS, WHERE IT IS AND WHAT'S BEING DONE ABOUT IT

When it comes to issues pertaining to the state of Long Island's sole source aquifer in 2019, there is no question that 1,4-dioxane tops the list.

The contaminant, which has been detected in approximately 70% of Long Island public supply wells, has been covered extensively by the news media. Environmental advocates and other concerned stakeholders have lobbied for it be regulated. State regulators have taken steps toward doing so. Public water suppliers have been supportive of efforts to ensure the continuance of a high quality water supply while also noting the extraordinary high costs a stringent 1,4-dioxane regulation will bring, as well as the impossibility of designing, receiving approval for, developing and putting into service the specialized treatment needed to eliminate the chemical from the water supply on a short timeframe.

Below is a brief look at what 1,4-dioxane is, where it's been found and what's being done to remove it from groundwater.

1,4-Dioxane: What it is, and How it Reached Long Island groundwater

1,4-dioxane is a synthetic organic chemical historically used as a stabilizer for industrial solvents, predominantly 1,1,1-trichloroethane (TCA), which was banned in the 1990s and is no longer used. Apart from its widespread use as a solvent stabilizer from the 1950s through 1990s, it is used in small concentrations in a variety of applications, such as inks, adhesives and pharmaceuticals. It is also present in various household products such as detergents, shampoos, and cosmetics as a byproduct of the manufacturing process.

The chemical reached the groundwater beneath Long Island primary due to industrial manufacturing operations on Long Island that used TCA stabilized by 1,4-dioxane for approximately four decades. Whether it reached groundwater via routine spills or direct disposal, once it reached groundwater it could persist for many years. 1,4-dioxane can also contaminate groundwater through consumer use of the many household products containing the chemical when such products are washed down drains and eventually make their way to the aquifer system.

The Health Risks Associated with 1,4-Dioxane

The U.S. Environmental Protection Agency considers 1,4-dioxane as a probable human carcinogen. The agency calculates a one-in-a-million increased lifetime cancer risk for those consuming two liters of water per day for 70 years containing 0.35 parts per billion of 1,4-dioxane. Damage to the liver and kidneys has also been observed in rats exposed to 1,4-dioxane in their drinking water over long periods of time.

Efforts to Regulate 1,4-Dioxane

The 12-member New York State Drinking Water Quality Council, created via state law and consisting

of eight members selected by Governor Cuomo and four selected by the New York Legislature, held its first meeting in October of 2017 with an initial task of assessing the potential need for state water quality standards for 1,4-dioxane and the perfluorinated compounds perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS).

In December of 2018, the council recommended state maximum contaminant levels (MCLs) of 10 parts per trillion (ppt) for PFOS and PFOA and 1 part per billion (ppb) for 1,4-dioxane. The council's recommendations were opened to a 60-day public comment period (which produced more than 4,000 comments) and forwarded to the state health commissioner, who has the option of either accepting the recommendations as presented or proposing alternative MCLs. Any resulting proposed regulation is then submitted for adoption by the Public Health and Health Planning Council, subject to the approval of the state health commissioner.

As of the publication of this report, no action had yet been taken on the recommended MCLs. Once they are adopted, as is expected, public water suppliers will need to test their water within the timeframes specified in the regulations and comply with the adopted MCLs. If any violations of the new regulations occur, they would need to be reported to the public within 30 days.

SCWA's advanced oxidation process treatment system in Central Islip.

1,4-Dioxane

Detections of 1,4-Dioxane on Long Island and Treatment Strategies

What makes 1,4-dioxane the most newsworthy topic of the year is that it is prevalent in public supply wells all throughout Long Island—planning and implementation for 1,4-dioxane treatment is expected to begin at half the anticipated MCL, or 0.5 ppb, affecting more than 200 Long Island wells—and that eliminating the contaminant requires specialized and very expensive treatment systems. Unlike PFOS and PFOA, 1,4-dioxane cannot be removed through the use of granular activated carbon (GAC), a standard treatment already in place to remove other contaminants at many wells throughout Long Island.

In Nassau County, 134 wells were reported with detections of 1,4-dioxane above 0.5 ppb and 81 wells have had detections above 1 ppb. The Suffolk County Water Authority (SCWA), which supplies approximately 85% of Suffolk County, reported 75 wells with detections above 0.5 ppb and 31 wells with detections greater than 1 pbb. Additionally, the South Huntington Water District reported three wells with detections of 1, 1.1 and 1.4 ppb, the Greenlawn Water District one with 1.1 ppb and the Dix Hills Water District one with 1.24 ppb (though, as the Suffolk County Department of Health Services noted, these detections may have been prior to treatment or blending or while a well as was run to waste, and may not be indicative of water delivered to the public.)

Though the chemical does not respond to GAC treatment, innovative treatment systems have been developed by Long Island water suppliers. Both SCWA and the Bethpage Water District have developed advanced oxidation process (AOP) systems that have been approved by the state to eliminate 1,4-dioxane. AOP works by introducing an oxidant to raw groundwater, then passing that mixture through an ultraviolet light reactor. The ultraviolet light reacts with the oxidant to create free radicals which destroy the 1,4-dioxane molecules. The water then passes through a GAC filter to remove the peroxide and any by-products from the reaction. The technology is still new and being monitored closely, but early results show SCWA's AOP removing more than 99% of all 1,4-dioxane from groundwater.

However, as a new treatment that generally needs to be, the process of taking an AOP system from the design stage to a fully operational system is extremely cumbersome and time consuming, hence the calls by water suppliers for a reasonable phase-in period in conjunction with the establishment of a new drinking water standard.

To illustrate that process, the SCWA Engineering Department provided the following guide to the steps taken on a typical AOP system application:

- Identify that there is 1,4-dioxane contamination after thorough water quality testing.

- Once this has been established, contact a manufacturer of the AOP system, send them water from the site so they can conduct their own water quality tests to determine what size reactor is needed based on the site's particular groundwater characteristics (presence of nitrates, clarity of water, etc.) This process takes about one month.

- Contract drawings and specifications (piping, electrical, controls) are then prepared based on the manufacturer's feedback. This takes approximately 6 months.

• Once drawings and specifications are complete, an application is submitted to the New York State Department of Health (NYSDOH) and Suffolk County Department of Health Services (SCDHS). (It is important to note that SCWA submitted an application in 2018 to the NYSDOH for a planned AOP system to be constructed at a well field in East Farmingdale and comments were returned from NYSDOH approximately one year later.)

• NYSDOH, in conjunction with SCDHS, then assesses the application and sends back comments.

• A resubmittal to the state is made addressing any comments requested (for the existing AOP system at a well field in Central Islip, for instance, the state and county had multiple rounds of comments and had 40 comments on the first round regarding various aspects of the application).

• Once NYSDOH officials are satisfied with the application, the process goes to bid. It generally takes a minimum of a few months from the beginning of the bid process to the awarding of a contract.

• There is then a process of conforming the contract, including fulfilling insurance requirements. This process generally takes at least six weeks.

• The next step is the submittal process, which involves working with a contractor on the various other aspects of the project, such as constructing piping, electrical systems, AOP system and controls, a building to house the equipment and various site work. The contractor submits shop drawings and cut sheets for all equipment to be provided for the project. The shop drawings and equipment cut sheets have to be reviewed and either approved or rejected. This process can take approximately four weeks.

• Once the shop drawing process is completed, the equipment and building has to be ordered and it can take two to six months to get all equipment and building components and then another four to six months for construction.

• Once the AOP system has been completely installed and all work completed, the system is started up. Start up has to confirm the proper operation of all equipment, controls, alarms and analyzers. Once proper operation has been confirmed, water quality testing is conducted. Water quality testing also includes testing for by-products by an offsite laboratory. The by-product testing alone takes at least two weeks to get results back. This process will take approximately one month.

• Water quality test results are then submitted to the NYSDOH so they can evaluate the effectiveness of the system. SCDHS also has to conduct an on-site inspection of the treatment system before it can be approved to operate.

• When NYSDOH officials are satisfied with the results of the tests, the AOP system is tied in the SCWA SCADA system.

It's important to note that this assumes that the state will not require pilot testing for any additional AOP

1,4-Dioxane

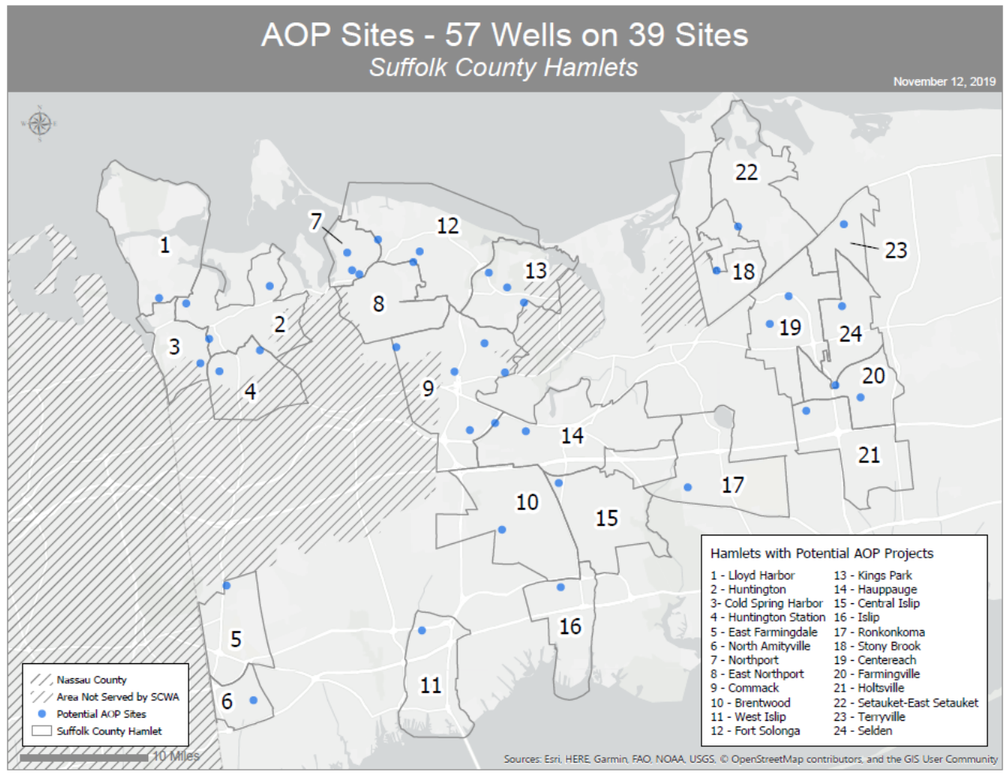
systems, such as was required with the AOP system located in Central Islip. The state has not yet made a decision on this aspect. Pilot testing would add substantially to this timeline.

It's also important to note also that dozens of applications for AOP systems—far more than the two that have been approved to date—will be forthcoming for state approval at virtually the same time once a new water standard is established.

The Cost of 1,4-Dioxane Treatment

In addition to the lengthy process for bringing an AOP system from design to operation, AOP systems are extremely expensive to build; costs for each system are estimated to range from more than $1 million to $6 million.

SCWA, for instance is anticipating capital costs for the 56 AOP systems and 20 GAC systems needed to meet the new water quality standards to exceed $114 million. In addition, annual operating costs for the new treatment systems are expected to cost $1 million per year initial and rise to an estimated $22 million per year when all systems are operational. With total costs over the next six years expected to potentially exceed $177 million, the utility in November approved a $20 quarterly water quality fee to be added to customer bills. Across Long Island, treatment costs for the new regulations are expected to reach as much as $840 million in total.



Sites in the SCWA service territory that will need treatment to remove 1,4-dioxane.

The 2018 State of the Aquifer update took a long look at precipitation, groundwater and surface water conditions on Long Island and their historic trends. This year's update focuses on more recent data. It was noted in the 2018 update that precipitation is the only means by which water enters Long Island's aquifers. Approximately half of all precipitation recharges the aquifers, roughly one million gallons of water per day for each square mile of land. Recharge occurs during the non-growing season (October to May). From June through September, aquifer recharge is minimal. As noted in last year's report, precipitation had been below normal for much of the previous 10 years, leading to a significant cumulative deficit. This all changed beginning in late 2017. Since that time, precipitation has been significantly above normal, and both groundwater levels and stream flows are now back to normal or above normal.

Precipitation in Recent Years

Normal, or long-term average precipitation for a given site, is calculated based on weather statistics from the previous three decades. This data is then updated at the beginning of each new decade. For example, normal precipitation levels for the current decade (2011 to 2020) are the average values from 1981 to 2010. In 2021, these normal levels will be updated using averages from the period 1991 to 2020. In this manner, changing climatic patterns are accounted for, but do not skew the data excessively for any given decadal period.

The current value for normal annual precipitation for Long Island MacArthur Airport is approximately 46 inches. For this SOTA update, rather than utilizing calendar years as was done previously, precipitation records from MacArthur Airport were examined in one-year increments for the period of September 1, 2017 to August 31, 2019. Data for the MacArthur Airport precipitation gauge was downloaded from the National Oceanographic and Atmospheric Association (NOAA) website: www.ncdc.noaa.gov.

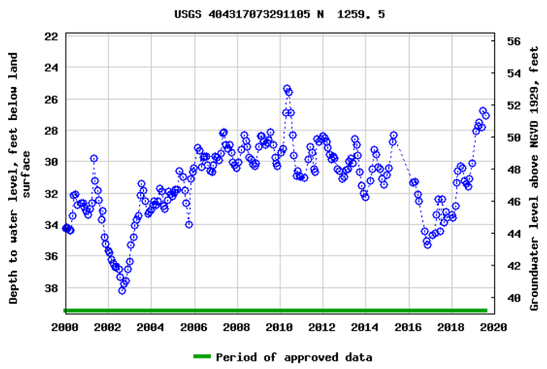
As expected, precipitation was above normal for the entire two-year period. Between September 1, 2017 and August 31, 2018, MacArthur's precipitation totaled 53.5 inches. For the period of September 1, 2018 to August 31, 2019, MacArthur's precipitation totaled 58.14 inches. Groundwater levels and streamflows reflect this recent higher-than-normal precipitation trend, as shown in the diagrams in the ensuing pages.

Background information pertaining to specific wells and streamflow gauges represented in this section can be obtained from the USGS report entitled "Statistical Analysis of Long-Term Hydrologic Records for Selection of Drought-Monitoring Sites on Long Island, New York," accessible at the following web address: https://pubs.usgs.gov/sir/2004/5152/sir20045152.

Groundwater Levels

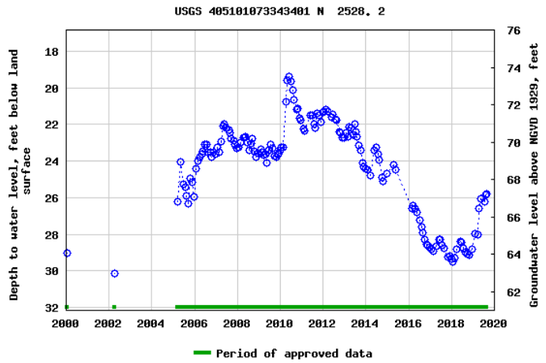
It was noted in the 2018 update that aquifer levels on Long Island have fluctuated historically due to human influences such as pumping and sewering and fluctuate seasonally due to precipitation, recharge and evapotranspiration. Regardless of these stresses, groundwater levels beneath most of Long Island are usually highest in March, April and May and lowest in September, October and November. The following is an update of some of the well data originally presented in 2018, with the focus being on the period from 2000 to the present.

N 1259.5. This well is located in eastern Nassau and is 41 feet deep.



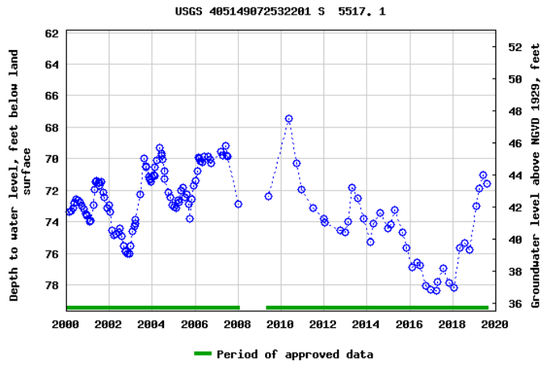
This hydrograph shows that water levels in the upper glacial aquifer in this portion of Nassau County are continuing to recover from their recent lows in mid-2017. As of this writing, water levels in this well are approaching the highest they have been in a decade.

N 2528.2. This Magothy aquifer monitor well is 328 feet deep.



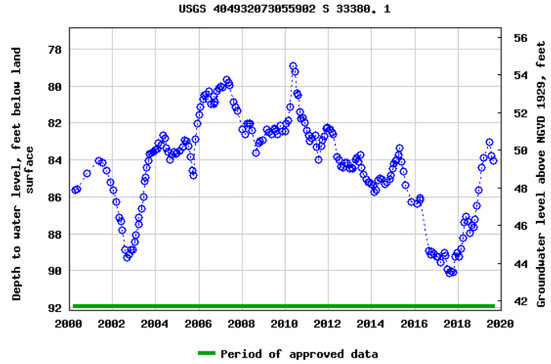
The lowest water level ever recorded in this well was +59.12 feet mean sea level (MSL) in early 1967, just after Long island's historic drought period of the mid 1960s. The most recent low was approximately +63 feet MSL in early 2018. While recovery has been significant from that 2018 low, its water level is still below historic average.

S 5517.1. This 91-foot deep upper glacial aquifer monitor well is located near Brookhaven National Laboratory.



As the hydrograph shows, the 2017 to early 2018 period saw extremely low water levels in the upper glacial aquifer in this portion of east-central Suffolk County. The hydrograph also shows that water levels have recovered approximately seven feet since 2018 to approximately long-term average.

S 33380.1. This well is located in Ronkonkoma in central Suffolk County. It is 855 feet deep and monitors water levels in the deepest portions of the Magothy aquifer.



Water levels in this well have recovered by more than six feet from its most recent low in late 2017. Water levels now approximate long-term average conditions.

Streamflows

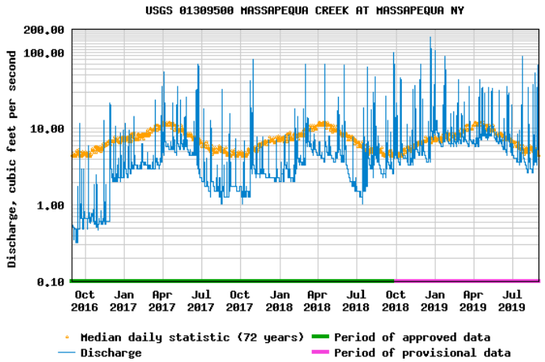
Since all of Long Island's streams are in direct hydraulic contact with the upper glacial aquifer, their flows closely reflect changes in the water table altitude. The 2018 SOTA update showed hydrographs from six Long Island streams, reflective of different conditions of development or urbanization within their watersheds. This update focuses on three of these waterways: Massapequa Creek (highly developed), Peconic River (minimally developed), and Connetquot River (an intermediate level of watershed development).

As with groundwater levels, streamflows fluctuate throughout the year, from their highs in the spring to their lows in late summer. For each of the hydrographs below, the orange line represents the historical average flow and the blue or red line represents the actual measured discharge. For this year's update, the focus is on 2016 to 2019 data, to better represent recent precipitation trends.

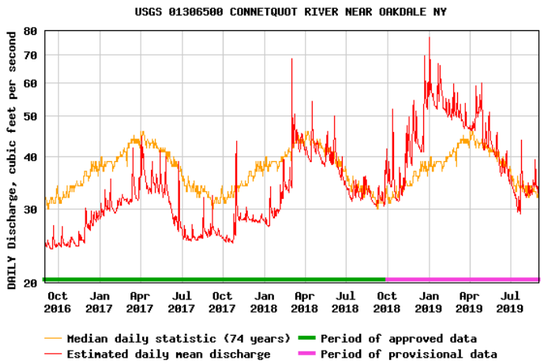
Massapequa Creek. The flow of all Nassau County streams reflects the significant human impacts of sewering and pumping on water levels within the upper glacial aquifer.

Discharges have decreased markedly since the 1960s and have not recovered due to these impacts.

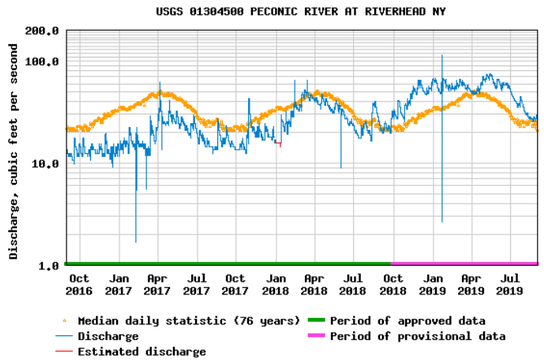
The discharge of Massapequa Creek since 2016 reflects the larger precipitation trends. Discharges were largely below historical averages until late 2018. Since that time, stream flows have recovered to close to long-term average.



Connetquot River. This stream borders areas showing significant human impacts (to its west) and minimal human impacts (to its east). Streamflow had been below normal for more than two years from 2015 to early 2018. Since 2018, discharge has been largely above long-term average values. In early 2019, discharge was significantly above average, but has subsided since then to approximately average values.



Peconic River. Flow for this stream in eastern Suffolk reflects a largely undeveloped watershed. Flows were well below normal for more than two years, finally recovering to near normal by early 2018. Since late 2018, flows have been above normal.

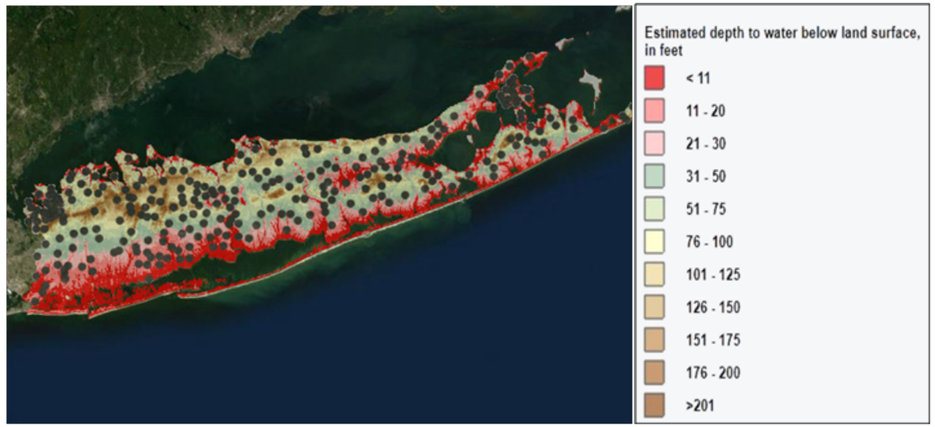


The data displayed in the graphs in this section show that Long island has experienced the full spectrum of hydrologic conditions in a very short time frame, from record or near-record lows as recently as 2017 to generally above normal levels currently. The abundance of groundwater and surface water data collected by the United States Geological Survey and other agencies over a long period of time ensures that water suppliers, regulatory agencies and the public are well informed about groundwater and surface water conditions at any given time. This data is an invaluable aid in making decisions to protect both public health and the health of the environment.

Hydrologic Conditions

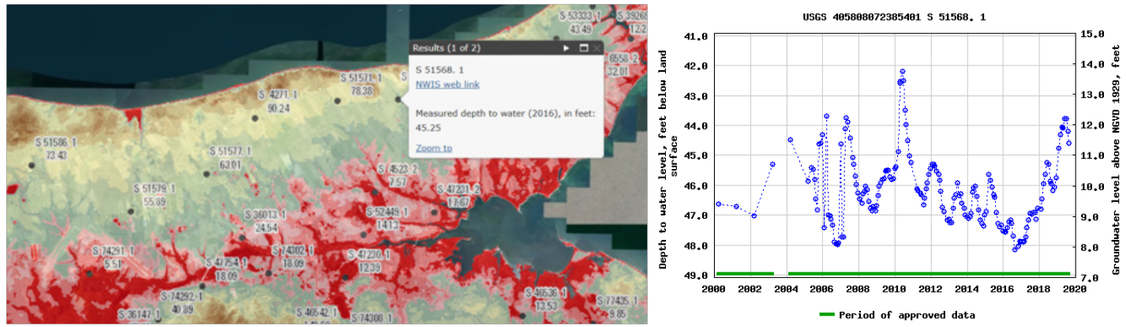
How can I find out more information on Long Island's Hydrologic Conditions?

The USGS maintains a depth-to-water map for Nassau and Suffolk Counties. The map is shown below, with the color coded intervals to its right. Each color represents a depth below land surface interval, below which groundwater will be encountered. Also shown below (as black dots) are the locations of USGS monitoring wells that were utilized in creating the map.



The map is fully interactive and available at the following web address: https://ny.water.usgs.gov/maps/li-dtw/.

To use it, click on a monitoring well to get a measured depth to water, or click elsewhere on the map to get an estimated depth to water. The map allows the user to zoom in to a particular area for greater detail.
Below is an example of a close up of the depth to water in eastern Suffolk County. When the user clicks on a particular monitoring well (in this case well number S-51568.1), its information is displayed, including a link to its historical water level record. Clicking on the "NWIS web link" will display the hydrograph shown to the right of the figure. The user can then specify a particular time period for which data is desired and see a graph of water levels within that time period.



By utilizing this and other publicly-available websites and web tools, anyone can obtain instant information on hydrologic conditions anywhere in Nassau and Suffolk Counties and compare current data with past trends.

Groundwater Pumpage

Groundwater pumpage statistics are maintained by the New York State Department of Environmental Conservation (NYSDEC). All public water suppliers and other larger users of groundwater, such as golf courses, commercial establishments and most farms are required to submit pumpage records to the NYSDEC on a monthly or quarterly basis.

Public Supply Pumpage

The largest use of groundwater on Long Island, and the one for which records are most accurate, is groundwater used for public supply purposes. For this State of the Aquifer update, public supply pumping records for the past six years were reviewed and compared to current conditions. For 2019 pumpage, the period from October 1, 2018 to September 30, 2019 was used. The following conclusions can be drawn from this pumpage data:

Between 2013 and 2019, the average daily pumpage for Nassau County has been approximately 186 million gallons per day (mgd). For that same period, the average daily pumpage for Suffolk County has been approximately 227 mgd.

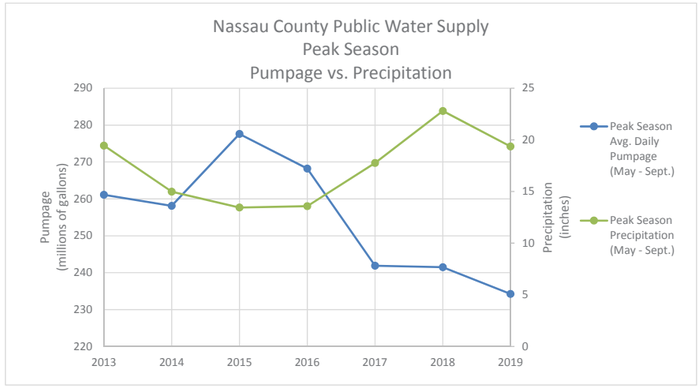
Public supply pumping during the peak season (May through September) is typically 100 to 200 mgd more than pumpage during the non-peak season (October through April). The two tables below list peak vs. non-peak pumpage from 2013 to 2019 for Nassau and Suffolk.

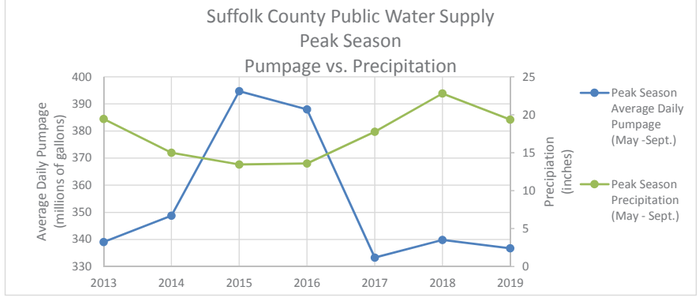
	Nassau Peak Avg. Daily Pumpage (mgd)	Nassau Non-Peak Avg. Daily Pumpage (mgd)	Nassau Avg. Daily Pumpage (mgd)
Year	May - Sept.	Oct.-April	All months
2013	261.13	135.10	188.00
2014	258.10	141.20	190.20
2015	277.61	138.26	196.67
2016	268.21	136.46	191.54
2017	241.89	134.69	179.63
2018	241.47	136.46	180.48
2019	234.23	126.84	171.86
Avg.	254.66	135.57	185.46

	Suffolk Peak Avg. Daily Pumpage (mgd)	Suffolk Non-Peak Avg. Daily Pumpage (mgd)	Suffolk Avg. Daily Pumpage (mgd)
Year	May - Sept.	Oct.-April	All months
2013	339.03	133.62	219.72
2014	348.74	143.56	229.57
2015	394.70	133.52	243.00
2016	388.01	135.97	241.33
2017	333.29	136.30	218.88
2018	339.83	139.46	223.45
2019	336.73	127.67	215.31
Avg.	354.34	135.73	227.32

Groundwater Pumpage

Given that the vast majority of peak season public supply pumpage is for lawn irrigation, precipitation during the spring and summer months is an important factor impacting water use. The graphs below illustrate the relationship between peak season precipitation and peak season public supply pumping.





Pumping for Purposes other than Public Supply

The Long Island Well Program (6 NYCRR Part 602) regulates water withdrawals for any purpose, other than public water supply, when the total capacity of such a well (or wells) on one property is more than 45 gallons per minute (gpm), or 64,800 gallons per day. This includes wells for domestic supply, agriculture, irrigation, open loop geothermal systems, temporary or permanent dewatering wells and others. Capacity is defined as the total withdrawal of all sources for a facility, independent of how each may be plumbed, or its designation (such as for redundancy, etc.). Capacity is determined by summing the maximum potential withdrawal of all the water source or sources, not by the typical or actual withdrawal.

There have been a series of changes to the regulation of agricultural wells over the years. Currently, agricultural wells are no longer exempt from Long Island Well regulations unless withdrawals had been (and continue to be) reported to the department prior to February 15, 2012. Even agricultural wells that were previously grandfathered in are required to obtain a Long Island Well permit and report withdrawals. There are approximately 120 golf courses on Long Island. Therefore, golf course irrigation represents a significant peak season (May through September) demand. Current Long Island Well permits cap golf course irrigation well pumpage at approximately 3 billion gallons annually.

Water Quality

EMERGING CONTAMINANTS

Emerging contaminants are chemicals that have been detected in water supplies at trace levels and for which the risk to human health is not yet known. One important class of emerging contaminants that has received a lot of attention in the past year are the per- and polyfluoroalkyl substances also known as “PFAS.”

Per-and polyfluoroalkyl substances (PFAS)

PFAS are a group of man-made chemicals that have been manufactured and used in a variety of industries since the 1940s. Two significant and extensively studied PFAS are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). These chemicals can be found in food packaging, stain and water repellent fabrics, non-stick products (Teflon) and numerous other household products. Firefighting foams were also a major source of PFAS groundwater contamination at places such as airports and military bases. Using the Environmental Protection Fund, the New York State Department of Environmental Conservation has initiated a program to remove and dispose of firefighting foam containing PFAS. Working with fire and emergency response departments throughout New York State, more than 25,000 gallons of contaminated foam has been collected and properly disposed of as of the summer of 2018. (Source: www.dec.ny.gov/chemical/108831.html).

In January 2016, New York became the first state in the nation to regulate PFOA as a hazardous substance. The regulation requires the proper storage of the substance and limited releases to the environment. It also enabled the state to use its legal authority and the resources of the state Superfund program to advance investigations and cleanups of impacted sites. The final rule for PFOA and PFOS became effective on March 3, 2017. By finalizing the regulation, the state has solidified its authority to hold polluters accountable whenever PFOA and PFOS contamination is found.

In May of 2016, the U.S. Environmental Protection Agency (USEPA) released a fact sheet setting a health advisory level of 70 parts per trillion for the individual or combined concentrations of PFOA and PFOS. The current USEPA health advisory is 70 parts per trillion (ppt) for PFOA and PFOS combined. However, in 2019, the New York State Drinking Water Quality Council recommended an a maximum contaminant level for PFOA and PFOS of 10 ppt individually. The deadline for comments about the council’s recommendations was September 23.

Increased public supply well pumping accelerates the downward flow of groundwater toward the land surface into the deeper parts of the system from which most public supply wells withdraw water (Ayotte and others, 2011). This, in turn, increases the potential for contaminants introduced at the land surface (including PFAS) to reach supply wells sooner than under normal groundwater flow conditions. As a result, the types and concentrations of these contaminants are often not foreseen until they actually reach the well screen, which then requires the water supply to be treated or the well to be taken offline. Advanced detection of these contaminants would allow water suppliers to better plan for treatment at the well head or to act proactively to avoid treatment altogether.

Customers served by a public water system can contact their local water supplier and ask for information on PFOA and PFOS in their drinking water and are encouraged to request a copy of the Consumer Confidence Report, which contains a complete listing of all testing conducted by a given water supplier that year. This report, which can often be found in electronic form on a water supplier’s website, lists the levels of contaminants that have been detected in the water, including those by USEPA, and whether the system meets state and USEPA drinking water standards. If you utilize a private well, USEPA recommends testing your drinking water regularly.

Qualified testing labs can analyze a sample of your water to determine whether perfluorinated chemicals are present and at what concentrations. In addition, USEPA recommends that residents reach out to their local public health department, which may be able to help provide support for testing or to seek such support from a

responsible party. You can also pay to have independent testing conducted at a qualified testing lab.

Recent Studies of PFAS on Long Island

In an effort to learn more about the emerging contaminants that may reach public supply well screen zones, the United States Geological Survey (USGS), together with members of the Long Island Commission for Aquifer Protection (LICAP) embarked on a cooperative study of these chemicals entitled "Sentinel Monitoring of Groundwater for Contaminants of Emerging Concern to Provide Advanced Warning for Supply Wells on Long Island, New York." This study and others like it have resulted in the creation of unique and effective tools to evaluate the availability and suitability of groundwater for supply on Long Island. Analytical capabilities have been developed by USGS laboratories to detect hundreds of agricultural, industrial and wastewater-related compounds at concentrations as low as the ppt level. Thirty-seven shallow (less than 100 feet deep) observation wells were selected to provide advanced warning of potential contamination before it reaches the most vulnerable parts of Long Island's supply well network. The project website can be found here: https://www.usgs.gov/centers/ny-water/science/sentinel-monitoring-groundwater-contaminants-emerging-concern-provide?qt-science_center_objects=0#qt-science_center_objects.

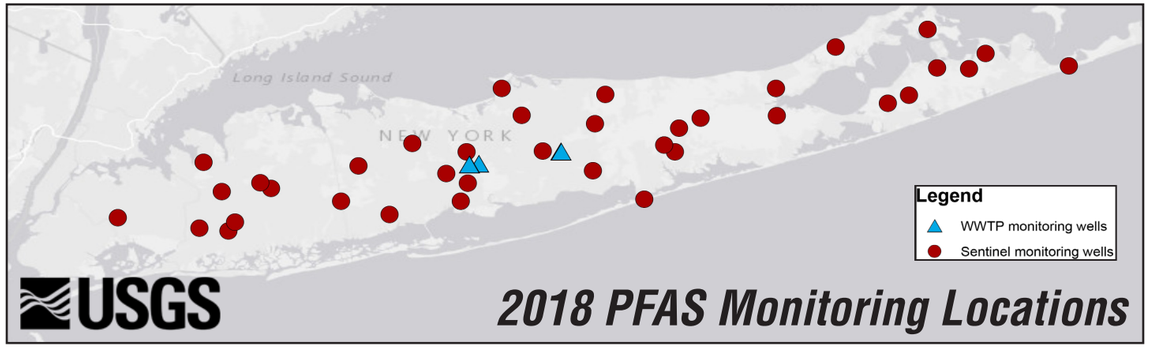
This study sampled 37 monitoring wells all screened within 50 feet of the water table and located in residential and mixed land use settings that primarily used onsite wastewater disposal systems. All groundwater samples collected in 2018 as part of this project were analyzed for PFAS and other emerging contaminants including pharmaceuticals, pesticides, 1,4-dioxane and other volatile organic compounds. PFAS data from this network of wells were compared to a separate network of shallow groundwater wells surrounding leach fields of three decentralized wastewater treatment systems serving an apartment complex, a strip mall and an assisted living facility and hotel combination.

A product of the above-referenced LICAP cooperative study was a second investigation entitled "Occurrence of Per-and Polyfluoroalkyl Substances in Shallow Groundwater, Long Island, New York." The USGS studied the occurrence of PFAS compounds in shallow groundwater in a variety of different land use settings. For this investigation, the USGS utilized two different networks of shallow monitoring wells: the previously mentioned network of 37 shallow monitoring wells and a sewage treatment plant network of shallow monitoring wells surrounding the leach fields of three different sewage treatment plants. All wells in this network are screened from 20 to 40 feet below land surface and all of the treatment plants discharge their effluent to groundwater.

Based on this investigation, the USGS made the following summary about the occurrence of PFAS in Long Island's groundwater:

- *PFOA, PFOS, and other PFAS are present in Long Island shallow groundwater;*
- *2018 shallow groundwater monitoring sites for PFOA and PFOS concentrations are below the EPA health advisory of 70 ppt for drinking water;*
- *Some of the 2018 shallow groundwater monitoring sites exceed the New York State Drinking Water Quality Council's recommended maximum contaminant level of 10 ppt for PFOA and PFOS;*
- *The variety and concentration of detected PFAS is related to land use;*
- *The greatest variety in PFAS was found at the sewage treatment sites for assisted living and hotel properties;*
- *The highest total PFAS was found at the sewage treatment plant for a strip mall.*

Water Quality



PFAS (and other emerging contaminants) are being studied in Nassau County as part of a cooperative study between the Nassau County Department of Public Works (NCDPW) and USGS entitled "Groundwater Quality of Nassau County, Long Island, New York." The primary objective of the study is to analyze groundwater quality samples collected from selected monitoring wells that are part of the existing and extensive monitoring well network maintained by the NCDPW. A secondary objective of the project is to provide these data to other stakeholders through a publicly-accessible database. Information pertaining to this study is available at the following website: https://www.usgs.gov/centers/ny-water/science/groundwater-quality-nassau-county-long-island-new-york?qt-science_center_objects=0#qt-science_center_objects.

USEPA Actions

In addition to the actions taken in New York, the USEPA is engaging in a cross-agency approach to addressing PFAS. The USEPA's PFAS Action Plan outlines steps the agency is taking to address PFAS and to protect public health. For drinking water, the agency is moving forward with the MCL process for PFOA and PFOS. The next step in the Safe Drinking Water Act process for issuing drinking water standards is to propose a regulatory determination. This provides the opportunity for the public to contribute to the information the USEPA will consider related to the regulation of PFAS in drinking water. Additionally, the agency will propose nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle. Monitoring results will improve understanding of the frequency and concentration of PFAS occurrence in drinking water. The USEPA's PFAS Action Plan can be found at the following web address: https://www.epa.gov/pfas/epas-pfas-action-plan.

Groundwater Contamination Associated with the Former Northrop Grumman Bethpage Facility and Naval Weapons Industrial Reserve Plant Site

Historic storage and disposal practices from 1942 to 1996 resulted in soil and groundwater contamination at the Northrop Grumman facility in Bethpage. The primary contaminants are volatile organic compounds that were commonly used by industries for degreasing purposes and disposed of on-site.

The New York State Department of Environmental Conservation (NYSDEC) issued a fact sheet on May 23, 2019 announcing the release of the Proposed Amended Record of Decision (AROD) for public review and the start of a 45-day comment period. The proposed AROD details the construction, long-term operation and maintenance of a full containment and treatment system to effectively halt further spread of the groundwater plume. The public comment period came to a close on July 8, 2019.

While the U.S. Navy and Northrop Grumman have taken remedial actions to address this contamination, groundwater contamination continues to migrate south

toward public water supplies that have not yet been impacted by the plume as well as to portions of the sole source aquifer. The following is a summary of the major site-related activities currently being completed by NYSDEC, Northrop Grumman, and the U.S. Navy. This information is available on the following website: https://www.dec.ny.gov/chemical/35727.html

NYSDEC Investigation and Feasibility Study Evaluating Supplemental Remedial Alternatives for the Navy Grumman Groundwater Plume

In February of 2017, NYSDEC initiated an expanded and expedited investigation of the Navy Grumman groundwater plume and an engineering analysis to evaluate cleanup alternatives. The NYSDEC partnered with the USGS and retained the engineering firm of Henningson, Durham, & Richardson Architecture and Engineering, P.C. (HDR).

Two vertical profile borings were drilled along the southern end of the plume near the Southern State Parkway to depths of approximately 1,000 feet. These boreholes were completed as permanent monitoring wells.

Water quality data from the site was utilized to create a comprehensive groundwater database, which contains over 200,000 individual records. The database was used to evaluate the plume and prepare updated two- and three-dimensional visualizations of the groundwater contamination. As per the most recent data, the groundwater plume extends more than four miles south of the Grumman Navy facility, and is more than two miles wide in some places. Its maximum depth extends 900 feet below grade.

An updated groundwater flow model was created by the USGS. This model was used in an engineering analysis and feasibility study to evaluate how various groundwater extraction and discharge scenarios influenced plume migration and groundwater containment, which ultimately led to the identification of a preferred remedy outlined in the proposed AROD. The proposed AROD identifies the preferred remedy and summarizes the other alternatives. To expedite the plume cleanup, the NYSDEC fast-tracked the drilling of four groundwater extraction wells in 2018 and 2019. These extraction wells were installed in areas with high concentrations of contaminants and will ultimately be one component of the overall plume remediation system.

Navy-Grumman Remedial Actions

Three recovery wells with a total capacity of two million gallons per day were recently installed in an off-site area (known as the RW-21 Area) with high contaminant concentrations. Northrop Grumman is developing plans to construct a treatment plant and conveyance system to return the treated water to the aquifer. This system is expected to be operating in 2020.

In 2019, drilling of in-situ thermal remediation wells began. These wells will address volatile organic contaminant contamination that remains in soil near the former Grumman settling ponds. This remedial measure began in mid-2019 and is expected to be completed by early 2020. Northrop Grumman is also designing a remedy involving excavation and off-site disposal of soil containing PCB and metals in this area. This excavation will follow the completion of the in-situ thermal remedy. In addition to these new efforts, Northrop Grumman continues to implement several past remedial actions. They are summarized below.

- *Since 1998, five on-site extraction wells have been removed contaminated groundwater from the aquifer. The contaminated water is then treated and returned to the aquifer through a series of recharge basins. This system has removed more than 200,000 pounds of contamination from the aquifer;*

- *A similar effort has been underway at Bethpage Park since 2009, using four extraction wells. So far, more than 2,200 pounds of contamination has been removed by this system;*

Water Quality

- *Northrop Grumman has been operating a soil vapor extraction system since 2009. After extraction, the contaminated soil vapor is treated and discharged to the atmosphere.*

In addition to these remedial activities, Northrop Grumman continues to implement a public water supply contingency plan. This plan involves monitoring groundwater quality in outpost monitoring wells to determine if wellhead treatment or alternative measures are needed to protect public water supplies.

U.S. Navy Remedial Actions

In accordance with several previous records of decision, the U.S. Navy continues to implement several older remedial actions, as described below.

- *Since 2008, The U.S. Navy has been pumping contaminated groundwater from two wells. This water is treated and pumped into a nearby recharge basin. This system has removed more than 10,000 pounds of contamination from the aquifer;*

- *Since 2009, the U.S. Navy has been operating a soil vapor extraction system which discharges treated soil vapor to the atmosphere.*

More recent remedial actions are listed below:

- *In 2018, the U.S. Navy began operation of a steam injection with liquid recovery system to address fuel oil contamination in the area of former underground storage tanks. The system is expected to operate for approximately one to two years;*

- *Site preparation work began in early 2019 for excavation and off-site disposal of approximately 45,000 cubic yards of soil contaminated with Polychlorinated Biphenyls from the Site 1 - former drum marshaling area. Excavation, disposal and site restoration is expected to be completed by early 2020.*

- *The U.S. Navy is currently designing a two million gallon per day groundwater extraction, treatment and disposal system targeting contamination in an off-site area (known as the RE-108 area). Operation of this system is expected to commence in 2020.*

Public Relations and Outreach

The U.S. Navy continues to hold Restoration Advisory Board meetings twice annually to allow the public to learn about current U.S. Navy activities and to ask questions. Additionally, as described above, the U.S. Navy continues with a long-term monitoring program and the public water supply contingency plan in cooperation with Northrop Grumman. The U.S. Navy and Northrop Grumman have provided funding to support the installation of wellhead treatment at six local public water supplies. This wellhead treatment allows the water purveyors to provide drinking water that meets New York State drinking water requirements.

Groundwater Monitoring

As described in last year's State of the Aquifer update, Long Island's governmental agencies have been monitoring the quality and quantity of groundwater beneath Nassau and Suffolk counties for nearly 100 years. This is accomplished by utilizing extensive networks of shallow and deep monitoring wells to conduct routine periodic monitoring of water levels and standard water quality parameters and by conducting special investigative studies when a specific water quality threat has been detected. This approach has helped to pinpoint aquifer contamination and has often triggered enhanced monitoring of public water supplies as an additional safeguard of public health.

Groundwater Monitoring – Nassau County

The Nassau County Department of Public Works (NCDPW) created in the 1940s and still maintains an extensive network of more than 600 monitoring wells in the major aquifers. Throughout the 1970s and 1980s, the NCDPW conducted its own sampling and testing of these wells and developed an extensive water quality database. In the ensuing decades, this aggressive sampling schedule has been cut back and/or eliminated largely due to budget cuts and loss of personnel. However, the monitoring well network still exists, and is available for others to sample as needed for specific investigations or for regional studies. Nassau's monitoring wells are currently being sampled by the Unites States Geological Survey (USGS) in conjunction with cooperative studies and by private consulting companies in conjunction with site cleanups. The monitoring well network is a valuable asset to all who require reliable water quality data. The figure below illustrates the extent of this monitoring well network.

One current cooperative project, funded by the New York State Department of Environmental Conservation and conducted by the NCDPW and the USGS, is entitled "Groundwater Quality of Nassau County, Long Island, New York." This project utilizes wells from the Nassau County network that are primarily screened in the Magothy aquifer and samples them for various contaminants of emerging concern including 1,4-dioxane. All well information, including sample results, will be stored in the USGS National Water Information System database at the following web address https://nwis.waterdata.usgs.gov/ny/nwis/nwis. A total of ten Nassau County wells were sampled in 2019.

Groundwater Monitoring

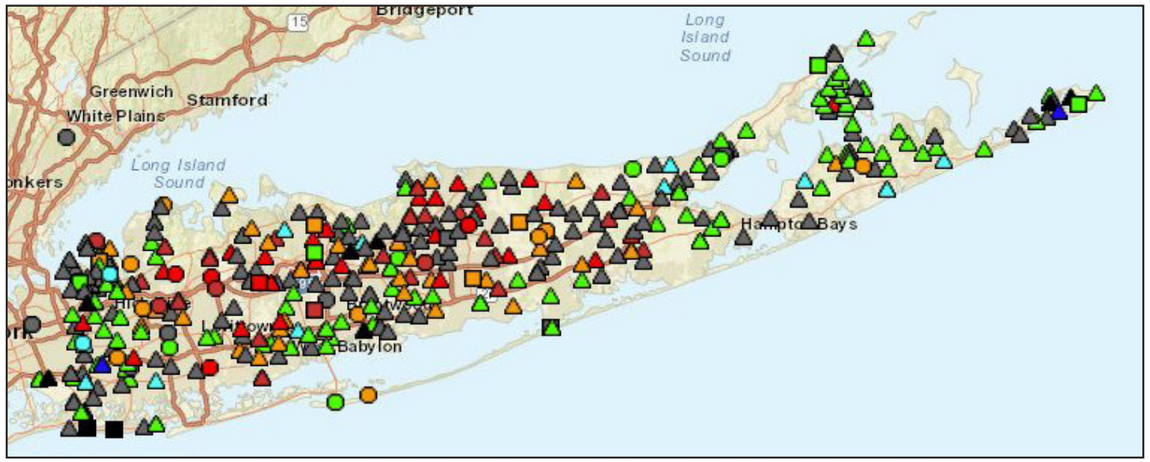
The NCDPW will be entering into a new, two-year cooperative agreement with the USGS in late 2019. Funding will be provided for the measurement of 15 continuous-recording observation wells, 50 monthly observation wells, 68 annual-synoptic observation wells and 15 water supply wells. Additionally funds will be provided for six real-time continuous-recording streamflow stations at five streams, 12 bi-annual streamflow stations, annual determination of start-of-flow positions at six streams, and saltwater intrusion monitoring at up to five saltwater outpost wells. Hydrologic data collected by this network of stations is used to monitor long-term conditions of the aquifers, provide data for water level and depth-to-water maps and provide data used in developing groundwater models. Information about this USGS cooperative program can be found at the following web address: https://www.usgs.gov/centers/ny-water/science/groundwater-quality-nassau-county-long-island-new-york?qt-science_center_objects=0#qt-science_center_objects.

Nassau County network wells have also been used to assist New York State Department of Environmental Conservation (NYSDEC) investigations of the refrigerant Freon 22 in Port Washington and in Glen Cove. The NCDPW network monitoring wells are also being utilized to monitor groundwater at numerous U.S. Environmental Protection Agency Superfund sites in New Cassel and at Roosevelt Field. Additionally, NCDPW wells have been used to develop a groundwater model for the village of Farmingdale and to assist in the remedial activities in Bethpage.

The Nassau County monitoring well network has proven to be an invaluable asset to water suppliers, regulatory agencies and private consultants that require groundwater information for their respective purposes.

Groundwater Monitoring – Suffolk County

Suffolk County established a monitoring network in the 1970s as part of its groundwater surveillance and investigative program. This network currently consists of more than 1,000 wells. Suffolk County also developed its own in-house well drilling and investigatory capabilities and continues these activities today. Hundreds of specific groundwater investigations have been conducted over the years in response to findings of significant contamination in either public supply



Wells within the Long Island Active Groundwater Level Network.

wells or in monitoring wells. For example, more than 80 vertical profile wells have been installed in Speonk to investigate volatile organic compound contamination found in private wells. A plume 1,000 feet wide and 2,500 feet long was delineated, and the data provided the basis for a Superfund application that resulted in public water being supplied to impacted homeowners. Similar investigations are underway in Hauppauge, Lindenhurst, Calverton and East Hampton.

Another example involves the 1996 NYS Pesticide Reporting Law, which mandated a monitoring program throughout the state. On Long Island, this study is being conducted by the Suffolk County Department of Health Services Bureau of Groundwater Resources. A key part of the program has been the establishment of a county-wide network of more than 200 observation wells to monitor pesticide and nitrogen use associated with various land uses. The sample results from the pesticide monitoring network have identified 109 pesticides in groundwater since 1997, with agricultural areas most heavily impacted. The results provide valuable data for several management and regulatory programs, including the Comprehensive Water Resource Management Plan and the NYSDEC Long Island Pesticide Use Management Plan.

Groundwater Monitoring – USGS

The USGS is involved in a variety of groundwater monitoring activities, not only for its numerous cooperative research projects, but also as part of its larger overall mission. The USGS has operated a groundwater monitoring network on Long Island—covering Brooklyn, Queens, Nassau, and Suffolk counties—since the early 1900s. The current groundwater monitoring network encompasses data collection from approximately 550 groundwater monitoring wells throughout Long Island. One of the principle functions of this network is to provide water level information that aids in the production of groundwater elevation maps for all of Long Island's aquifers. The depth-to-water maps described in a previous section of this report are a direct result of the use of this network of observation wells. A map showing the generalized location of the wells within the Long Island Active Groundwater Level Network is shown below.

Water quality information is also an important aspect of the USGS's groundwater monitoring efforts. In a previous section of this update, a study entitled "Sentinel Monitoring for New and Legacy Pesticides in the Shallow Groundwater of Long Island" was referenced. Under this study, wells from the 32-well National Water Quality Land-Use Study (NAWQALUS) network will be evaluated and re-established for monitoring of pesticide contamination. The network was originally designed to focus on areas that have experienced increased land development during the early 2000s. The entire network was sampled in 2006 as part of a larger assessment of Long Island and New Jersey. A subset of these wells was sampled again in 2011. Water quality monitoring at these wells will focus on current and legacy pesticides, pesticide degradates, and nitrogen and phosphorus compounds associated with both agriculture and with residential turf maintenance.

Another current cooperative program between the USGS and the Suffolk County Department of Health Services (SCDHS) supports the New York Pesticide Monitoring Program by monitoring shallow groundwater in agricultural settings in Suffolk County. The design of the NAWQALUS well network complements the SCDHS agricultural land-use observation well network. Provisional data from this project will be compiled and shared with the NYSDEC and SCDHS as soon as it becomes available. This analysis will also consider how different land-use practices impact water quality and how different soils, sediments, and geochemical conditions on Long Island may contribute to the vulnerability of groundwater to pesticide contamination. This study will ultimately provide the NYSDEC, SCDHS and other stakeholders with information needed to carry out their mission of protecting Long Island's sole source aquifer system by supporting the NYSDEC Long Island Pesticide Pollution Prevention Strategy. Additional information on these groundwater monitoring activities can be found at the following web address: https://www.usgs.gov/centers/ny-water/science/sentinel-monitoring-new-and-legacy-pesticides-shallow-groundwater-long?qt-science_center_objects=0#qt-science_center_objects.

Groundwater Monitoring

One of the most important groundwater monitoring projects undertaken by the USGS is known as the Long Island Sustainability Study. Its official title is "Groundwater Sustainability of the Long Island Aquifer System." Groundwater sustainability can be defined as the development and use of groundwater in a manner that can be maintained for an indefinite time without causing unacceptable environmental or socioeconomic consequences. This study will evaluate the sustainability of Long Island's groundwater by performing hydrogeologic mapping, monitoring of water quality and water levels and developing a groundwater-flow model for this sole source aquifer system.

One of the most important components of the sustainability study involves groundwater monitoring to evaluate the movement of the salt water interface. Salt water intrusion is the most common type of water-quality degradation in coastal plain aquifers. Prior to the beginning of large scale groundwater pumping (known as "predevelopment" conditions), the groundwater elevation is higher on land than in the surrounding salt water bodies. Therefore, fresh groundwater naturally flows from land toward the sea (from areas of high to low elevation) and eventually meets salt water offshore at an equilibrium point known as the interface. If these natural conditions are reversed by excessive pumping, fresh groundwater flows toward the pumping well instead of seaward, the interface moves landward and salt water intrusion occurs.

The predevelopment concentration of chloride in fresh groundwater beneath rural portions of Long Island was 10 mg/L or less, and typically 40 mg/L or less beneath more urbanized areas (since some land use practices add chloride to the groundwater). "Salt water" for purposes of this study is defined as groundwater with a chloride concentration greater than 250 mg/L, which is the drinking water standard for chloride. By closely monitoring pumpage data from production wells, the USGS has delineated active salt water intrusion at a number of locations across Long Island, including in areas of northern Nassau County, over the past 50 years. As part of the Sustainability Study, water samples collected by the USGS and other agencies from both observation and production wells across Long Island will be analyzed for chloride concentrations. In many areas of Long Island, there is little to no information regarding the current location and concentration of salt water in the underlying aquifers. Delineating the current extent of the salt water interface is essential to resource management decisions and providing the necessary information for the USGS to produce an accurate computerized groundwater model. Additional information regarding the Long Island Sustainability Project can be found on the web at the following address: https://www.usgs.gov/centers/ny-water/science/groundwater-sustainability-long-island-aquifer-system?qt-science_center_objects=0#qt-science_center_objects.

Water Conservation

With each passing year, more attention is paid by water suppliers, municipalities and the general public to the need to conserve our groundwater supply, a constantly recharged but still finite resource that is essential to Long Island's continued prosperity. LICAP led the way this year in establishing its own water conservation educational program called Our Water Our Lives, which is covered in detail elsewhere in this report. Below is a look at some of the other conservation programs underway across Long Island.

Suffolk County Water Authority's "Water Wise" Programs

The Suffolk County Water Authority several years ago initiated a series of steps to encourage water conservation by its customers. One such initiative is called the SCWA Water Wise Checkup. A SCWA Water Wise Checkup is a free, one-on-one consultation between residents and an SCWA water use expert. Under the program, the expert will go to the resident's home and ask a series of questions to estimate daily total water use. These checkups identify each point of water use inside and outside the home and estimate the quantity of water used at each of these points. The goal is to identify and quantify unaccountable water losses, ultimately providing the customer with a road map for potential savings. The expert will also show the homeowner how their water use compares with the average usage of other customers in the area.

SCWA also offers customer account credits of up to $50 for the purchase of water saving devices such as faucet aerators and smart irrigation controllers. And a public education forum begun by SCWA three years ago called WaterTalk includes a water conservation component. Additionally, SCWA adopted a conservation rate in 2019 to encourage the judicious use of water resources.

Port Washington Water District's "Be Smart and Green, Save 15" Program

Noting that the district's wells may become at risk for saltwater intrusion unless water pumpage is reduced, the Port Washington Water District initiated a program called "Be Smart and Green, Save 15" to encourage water conservation. (The "15" in the title refers to an effort led by the New York State Department of Environmental Conservation to get water suppliers on Long Island to reduce peak season water pumpage by 15%).

The program was designed to educate residents about the ways they can easily reduce water consumption and to encourage residents to strictly adhere to Nassau County's odd-even lawn watering ordinance. The district also implemented a distribution leak-detection program that identified numerous locations where water had been being wasted. Just by fixing those leaks, the district estimated that more than 113,000 gallons of water per day had been saved. The district also consults with its top water users—a tactic also used by SCWA—to encourage them to use water more efficiently.

In 2016, the district pilot-tested EPA WaterSense smart irrigation controller technology at its administration building, resulting in significant water use reduction (while still maintaining a green lawn). The district has already saved many tens of thousands of gallons of water just by taking this easy step.

Roslyn Water District's "Save 2 Minutes" Program

The Roslyn Water District built upon a successful initiative launched in 2015 which staggered irrigation schedules by community, thereby dramatically improving peak water availability, by creating a program called "Save 2 Minutes" with a goal of cutting up to 10% of annual irrigation water usage. The program seeks to encourage residents to cut just two minutes of watering from each zone of their lawn, which the district estimates will cut usage by 10% while still ensuring a green lawn.

New York American Water's "H2O Control Conservation" Program

To help its customers identify opportunities to conserve water and save money, New York American Water executed an analysis of the water use habits

Water Conservation

of its customers. The result was the "H2O Control Conservation" program, which includes the following components:

- Outdoor Water Savings How-To Kits: An outdoor conservation kit with tips and tools for reducing outdoor water usage.

- Indoor Water Savings Retrofit Kits: An indoor conservation kit includes a water efficient showerhead, aerators, toilet tank bank and leak detection tabs, and a leak detection guide that provides tips for detecting indoor and outdoor leaks.

- Water Use Calculator: An online tool that allows customers to input water use information specific to their household and offers tips on where they can save water and energy based on that data.

- Irrigation Home Assessments: Evaluates whether your irrigation system is in good condition and set up correctly to apply the right amount of water in the right places at the right time.

- Rachio 3 Smart Irrigation Controller Incentive Program: Customers who have qualifying irrigation systems and used more than 15,000 gallons of water per month during the summer may be eligible to receive a smart irrigation controller (valued at $230+) for $99.

- Evapotransporation (ET) Notifications: Customer notifications will be sent via social media to use water more efficiently based on rainfall.

- Improved Customer Website (MyAccount): Enables customers to see monthly usage for the last three years and comparisons of that usage to their neighborhood averages. The new site will also enable customers to create alerts and choose how to receive them – by email, text or mail.

- Water Use Alerts: Provides customers with mid-month notifications to keep them informed of their water use and provide them with an opportunity to conserve before their billing cycle ends.

Notable LICAP Achievements

The achievements of the Long Island Commission for Aquifer Protection (LICAP) in 2019 were highlighted by the creation of a comprehensive public engagement campaign to encourage Long Islanders to conserve our aquifer system and the development of a groundwater management plan for Long Island.

Our Water Our Lives

In 2018, LICAP created a new subcommittee with a dual mission of educating Long Islanders about the sole source aquifer that provides all of Long Island's drinking water and developing a public awareness campaign to encourage residents to conserve our valuable groundwater resources.

The Conservation Subcommittee began meeting in July of 2018 with active participation from representatives of the following agencies/organizations/elective offices: Center for Water Resources Management at NYIT; Citizens Campaign for the Environment; Cornell Cooperative Extension; Green Choices Consulting; Irrigation Association of New York; Long Island Regional Planning Council; Long Island Water Conference; Lloyd Harbor Conservation Board; Massapequa Water District; Nassau County Executive's Office; Nassau County Comptroller's Office; Nassau County Legislature; Nassau County Soil and Water Conservation District; New York American Water; New York League of Conservation Voters; Open Space Council; Peconic Green Growth; Perfect Earth Project; Port Washington Water District; Scotts Miracle-Gro; Smithtown Town Planning Department; Southold Town Planning Department; Suffolk County Executive's Office; Suffolk County Department of Economic Development and Planning; Suffolk County Legislature; Suffolk County Soil and Water Conservation District; Suffolk County Water Authority; SUNY Stony Brook School of Marine and Atmospheric Sciences; US Geological Survey; Water for Long Island; and Westhampton Beach Conservation Advisory Council.

Though the subcommittee spearheaded conservation initiatives such as the Suffolk County Water Authority Board's prohibition of large tanker trucks filling up from hydrants in the Town of Southold (and thus depleting the area's shallow aquifer), its primary focus in its first year of existence was the creation of the "Our Water Our Lives" water conservation campaign.

The multi-platform campaign—which included the creation of thematically-linked digital ads, social media pages, a website, and free merchandise for the public affixed with the campaign logo—kicked off at a press conference/open house at the Suffolk County Water Authority Education Center in Hauppauge last May, featuring stakeholders from all over Long Island and remarks from Suffolk County Executive Steve Bellone.
"For years, Suffolk County has been leading the state as

Notable LICAP Achievements

we work to improve and protect our water, which includes the sole source of our drinking water—our aquifers," said Suffolk County Executive Bellone at the event. "I applaud LICAP for their steadfast effort to educate Long Islanders on the importance of water conservation and small steps that can be taken to safeguard our water supply. Water is the lifeblood of Long Island and I look forward to continuing to work together to preserve it for years to come."

To develop a theme/logo that resonated with the public, the subcommittee conducted multiple internal and public polls with statistically-relevant results offering a wide variety of design choices. After a comprehensive process and significant public input, including feedback from a focus group, the subcommittee chose the overall theme of "Our Water Our Lives" with the tagline "Save Long Island's Only Drinking Water Source." The logo features a dark blue/light blue color scheme and a silhouette of Long Island.

The associated website and digital ad campaign, designed by the marketing company Affirm, incorporate the logo and are designed to help Long Islanders see the connection between our lives and our underground drinking water supply. In total, LICAP invested $125,000 of state grant funds in the creation of the campaign and its corresponding digital advertisements, website and social media pages.

Following an advertisement introducing the campaign, the ad campaign focused primarily on three conservation measures: encouraging the use of smart controllers/rain sensors and other water-saving technology to help residents water their lawns more efficiently; encouraging the use of EPA WaterSense products for indoor water savings; and, for those who choose not to use water-saving technology, encouraging the adoption of alternate-day lawn watering, which saves water and promotes healthy lawns, as watering less frequently promotes deeper root growth. The ads delivered more than 15,000,000 display impressions on a variety of publications.

The website expands on these conservation initiatives, including an attractive display featuring ten easy ways for Long Islanders to save water. The site also features a page containing information about the aquifer system; a forum on which visitors can share their conservation ideas and discuss them with others; social media accounts; and a contact page so people can find out how to get involved with various conservation initiatives.
The site also features a pledge page where visitors can leave contact information and promise to take steps in their daily lives to conserve water. As of late October, approximately 3,100 people had taken the pledge.

The creation of the subcommittee was in part inspired by the New York State Department of Environmental Conservation's goal, announced in 2017, to reduce peak water use on Long Island by 15% over the course of the next several years.

The subcommittee in late 2019 began work on strategies to grow the "Our Water Our Lives" campaign brand. The result of those efforts will be covered in next year's SOTA report.

"A great deal of attention has been focused on groundwater and surface water quality issues recently, and while that's extremely important, the conservation of our aquifer system needs to be a focal point as well," said LICAP Chair Jeffrey W. Szabo. "With this brand and infrastructure in place, and with dozens of stakeholder organizations already involved, we feel this will be just the beginning of a long-term effort to ensure the viability of our groundwater resources."

Groundwater Resources Management Plan

A pillar of LICAP's mission since its inception has been the creation of a Groundwater Resources Management Plan, one of the two primary deliverables included in the commission's mission statement, along with this State of the Aquifer (SOTA) report.

Like the SOTA report, the Groundwater Resources Management Plan has been developed through the voluntary efforts of groundwater industry professionals.

Notable LICAP Achievements

The plan includes qualitative and quantitative groundwater data, historical context, recommended regulatory amendments and recommendations for actions to be taken to ensure the best use of our groundwater resources.

The plan aims to provide a clear picture of the specific threats facing the aquifer system and the potential damage that these threats may cause. It also will assess the adequacy of existing groundwater management regulations; create an action plan for the long-term sustainability of the aquifer; and create an implementation program charting the specific responsibilities of stakeholders and a prioritization of the next steps to take.

The plan is divided into an initial document developed in 2017 focusing on the development of management strategies for topics including climate change, geothermal heating and cooling systems, water conservation and the regulation of the Lloyd aquifer, and a second document, which is currently being finalized. The second document assesses topics including use of private wells, wastewater management, regulation of contaminants and the potential use of New York City water supplies to provide additional supply to Western Nassau wells.

Included in these combined plans are more than 140 specific recommendations prioritized as immediate, short-term and long-term concerns. In total, 20 recommendations are considered top priorities. They are:

- Investigating ways to optimize pumping for coastal wells;

- Funding the development of a regional groundwater model for planning purposes;

- Implementing conservation pricing for public water suppliers, and include a full description of water conservation pricing in annual water quality reports;

- Establishing guidelines for best management practices to reduce peak pumpage for landscape irrigation;

- Establishing guidelines for use of water by geothermal systems;

- Making the case against reactivation of public supply wells in Queens County;

- Identifying federal, state, and local funding sources to conduct groundwater monitoring, plume identification, and modeling;

- Actively remediating or strategically containing groundwater contamination plumes, such as the Grumman/Navy plume, to minimize and prevent potential impacts to public drinking water;

- Maintaining, updating and utilizing the existing Nassau County Department of Public Works monitoring well network;

- Expanding the development and use of the WaterTraq GIS-based contaminant mapping system;

- Requiring that water suppliers are notified when a geothermal system has been permitted in their service area;

- Requiring that the New York State Department of Environmental Conservation and the Nassau and Suffolk County Health Departments review and provide comments to municipal planning boards on projects that may impact water resources through the state SEQRA process;

- Reauthorizing LICAP for a second five-year term (accomplished in 2018);

- Basing any pumpage caps implemented in the future on scientific data;

Notable LICAP Achievements

- Preventing the creation of any new state or regional entity to provide oversight of drinking water resources, as those powers are already vested in the New York State Department of Health and the New York State Department of Environmental Conservation;

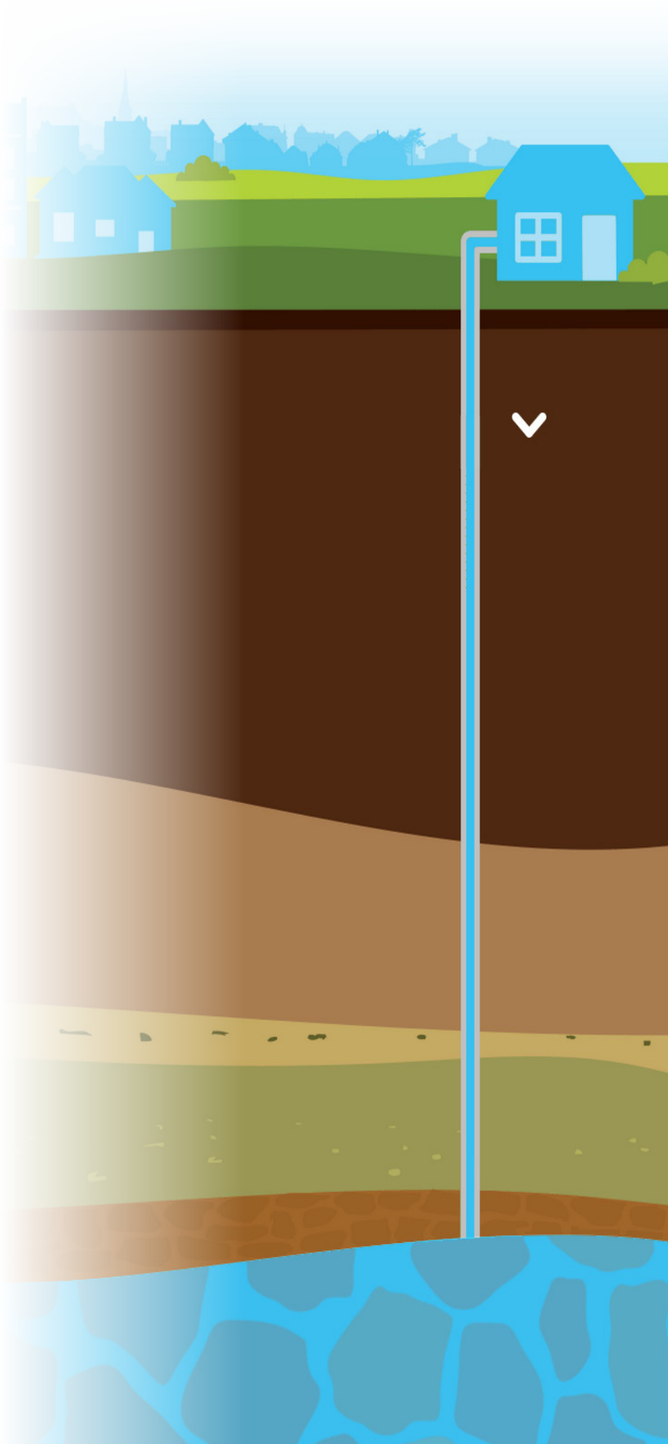
- Expanding programs in both counties to upgrade wastewater treatment in currently unsewered areas;

- Identifying and promulgating funding sources to enable impacted or threatened private wells in both counties to connect to public water;

- Identifying opportunities to enhance monitoring and regulatory enforcement efforts to prevent volatile organic compound release and mitigate contamination;

- Expanding monitoring capabilities under the NYSDEC Pesticide Monitoring Program, and support the Long Island Pesticide Management Strategy to minimize or eliminate excess pesticides via best management practices. Also, explore opportunities for inter-municipal agreements to enhance sampling via shared services;

- Expanding assessment/management programs for pharmaceuticals and personal care products (PPCPs), and enhancing monitoring for PPCPs, including 1,4-dioxane near wastewater discharges from sub-regional plants and individual on-site wastewater treatment systems; identifying wastewater treatment technologies that demonstrate PPCP reduction or removal; expanding support to local Stop Throwing Out Pollutants (STOP) programs; funding local laboratory capacity to analyze potential threats to public and private water supplies from emerging contaminants such as PFAS.



Concluding Thoughts

2019 marks the fourth State of the Aquifer report authored by LICAP, and the first since its five-year re-authorization by both the Nassau and Suffolk legislatures in late 2018. The document's new format, with several recurring topics and one larger feature story, will better reflect current issues relating to Long Island's groundwater.

Rainfall has continued to be above normal during the past two years, fueling a continuing rebound in groundwater levels and streamflows from the lows that they experienced in 2017. Because of continued high precipitation, groundwater pumpage has leveled off. However, occasional summer dry spells continue to strain water supply facilities and stress aquifers. LICAP, through its Our Water Our Lives campaign, has begun an initiative to educate consumers about their water supply and its finite nature. We anticipate that significant islandwide conservation efforts will stem from this initiative. Several Long Island water suppliers have already undertaken conservation programs on a local scale.

Water quality issues are hot topics impacting both Long Island's water suppliers and water consumers. After decades of sporadic cleanup efforts, the NYSDEC has announced a final comprehensive remediation of the Grumman/Northrop Bethpage plume. It is hoped that nearby water suppliers will be spared the cost of extensive wellhead treatment systems to remedy contamination from the plume. Newly proposed standards for emerging contaminants such as 1,4-dioxane, PFOS and PFOA continue to challenge water professionals, as they develop and employ new technologies to remove them from public water supplies.

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Since LICAP's inception in 2013, its board and staff have set as a top priority the creation of a Groundwater Resources Management Plan. With the help of LICAP's consultant, H2M Engineers and Architects, publication is expected of the plan is imminent. Given all of the issues impacting both groundwater resources and water supply facilities, LICAP anticipates that the plan will provide a roadmap toward managing these issues. The plan's many recommendations and in-depth analyses of pertinent issues impacting Long Island's water supply should provide groundwater professionals with an excellent management tool to ensure the health and viability of our island's most valuable asset – its groundwater resources.

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